Refractive errors: occurrence, aspecific health complaints & functional problems

Summary

Refractive error (RE), especially myopia, is related to visual acuity (VA) and ocular diseases. In addition to diminished VA and ocular diseases, the literature suggests that RE (especially hyperopia) also might cause non-visual complaints and functional problems. Although RE is suggested to cause aspecific health problems and functional problems, research on this relationship seems to be a neglected domain.
The aim of our research was to gain more insight in the relation between RE, aspecific health complaints and functional problems.

A literature search (chapter 2) was performed on the possible influence of RE on the occurrence of non-visual complaints and functional problems. The literature search included Medline searches (1966-2005) in which used keywords were: refractive error, hyperopia, myopia, complaints, symptoms, headache, fatigue, intelligence, reading, and dizziness. Moreover we searched in reference lists for other relevant articles. Articles published in English language (or with abstract in English) were included if the abstracts reported on possible relations between RE and medical complaints and/or functional problems.
Studies discussing the relation between RE and health complaints do not show consistent relations between RE and headache complaints or aspecific health complaints. Little if any robust evidence supporting the theory that RE causes headache complaints was found.
On the relation between RE and functional problems, a consistent pattern was found in which myopes score higher and hyperopes score lower on intelligence and reading tests, compared to emmetropes. Reading ability and school achievement show the same pattern. Reading ability might according to the literature be an intervening factor in the relation between refractive error and intelligence.
Research until now does not confirm RE as a cause of aspecific health complaints, but also does not exclude RE as a relevant factor in relation with aspecific health complaints and/or functional problems. If a relation between the occurrence of RE and aspecific health complaints and/or functional problems could be confirmed in future research, for many persons these complaints and/or problems could be avoided or diminished at relatively low costs.

During the last few decades the prevalence of myopia has increased worldwide, especially in Asia. We investigated the prevalence of habitual REs (i.e. without the use of a cycloplegium) and anisometropia in a Dutch population of children and employees (chapter 3). In a cross-sectional study REs of both eyes of 520 children (aged 11-13 years) and 444 hospital employees (aged 17-60 years) were measured using an autorefractometer (Topcon, RM-8000B). The measurements were performed without the use of a cycloplegium in order to best fit the refractive state in daily life. The Pearson correlation coefficient (r) was used to analyse correlations between right and left eyes. For testing differences between gender and age subgroups chi-square tests were used.

Among school children 28% of right eyes were myopic >0.50D and 8% hyperopic >0.50D. For sphere equivalent power (SEP) Pearson's r between right and left eyes was 0.93. Mean cylinder component in right eyes was 0.26D [0.00D to 4.50D]. Anisometropia >1.00D was present in 4.6% of children; 22% of children were not optimally (>0.50D) corrected.
Among hospital employees 30 % of right eyes were myopic >0.50D and 10% hyperopic >0.50D. For sphere equivalent Pearson's r between right and left eyes was 0.53. Mean cylinder component in right eyes was 0.35D [0.00D to 5.75D]. Anisometropia >1.00D was present in 25% of employees. In employees aged 40-60 years anisometropia was more frequently present than in employees aged 17-39 years (30% versus 18%, p=0.02, Cramer's V=0.15).
REs are common in schoolchildren aged 11-13 years and in hospital employees aged 17-60 years. Distributions of sphere and cylinder deviations are similar for Dutch school children and employees. Surprisingly, anisometropia proved to be more prevalent with age. In children many eyes (22%) are not optimally corrected.

In chapter 4 we aimed to gain insight into the relation between habitual RE (sphere and
astigmatism) and headache complaints in children. In a cross-sectional study the habitual refractive state of 487 children, aged between 11 and 13 years, was measured
using an autorefractometer (Topcon, RM-8000B). Headache complaints were measured
using a questionnaire. Data were analysed using Pearson correlation coefficients, bivariate analysis, and multiple logistic regression analysis.
For right eyes we found 15% habitual myopia < -0.50D and 12% habitual hyperopia >+0.50D; habitual astigmatism >0.25D was found in 33% of children. Pearson R between right and left eyes was 0.76 for the spherical component and 0.42 for the cylindrical.
In the total group of children 70% reported the occurrence of headache in the last year. These headaches were reported as "often or frequent" by 37% of children, "severe" by 15%, "with long duration" by 45%, and "with severe burden" by 27%.
In the total sample we found various associations between gender, sphere/cylinder components of habitual RE, and headache complaints. Headache was reported more in girls than in boys. Of the total variance of headache complaints in girls, the sphere component of habitual RE explained 4% of frequency, 6% of intensity, 2% of duration, and 2% of amount of burden. Of the total variance of headache complaints in boys the cylinder component of habitual RE explained 3% of frequency, and 4% in amount of burden.
Habitual RE and headache complaints are relatively common conditions in schoolchildren aged between 11 and 13 years. Headache complaints showed a small but statistically significant association with the sphere component of habitual RE in girls and the cylinder component of habitual RE in boys. The associations found between habitual RE and headache complaints, indicates that habitual RE might be a risk factor for headache in children.

Because uncorrected REs might induce lower school achievement, we investigated in chapter 5 the relation between habitual REs and school achievement. In a cross-sectional study the habitual refractive state of 464 children, aged 11-13 years, was measured using an autorefractometer (Topcon, RM-8000B). School achievement on areas 'language', 'mathematics', 'study skills', and 'world orientation' was measured using the Dutch CITO test. Analysis of variance (ANOVA) was used to investigate the relation between habitual RE and the CITO test scores.
High correlations between right and left eyes were found for all optometric measurements. Spherical component of habitual RE revealed prevalences of 13% for myopia <-0.50D and 11% for hyperopia >+0.50D. Astigmatism > 0.25D was found in 59% of children; of these 58% showed horizontal/vertical orientation and 42% oblique orientation.
For the total sample no relation was found between spherical and astigmatic components of habitual RE and school achievement scores. However, spherical ametropic girls not normally wearing an optical correction scored substantially lower than their emmetropic counterparts (10% on the total score and 9% on language). Also, astigmatic boys not normally wearing an optical correction scored lower (6% on total score, 8% on study skills and 7% on world orientation) than non-astigmatic boys. No relation was found between the orientation of astigmatism and school achievement scores.
Girls with spherical ametropia not normally wearing an optical correction and astigmatic children not normally wearing an optical correction performed substantially lower on their school achievement scores. In these children advice for further secondary education proved in general to be one school type level lower. As lower school achievement may be a consequence of small habitual RE, integration of early refraction screening in vision screening programmes is worthwhile to consider.

In chapter 6 we investigated the role of various habitual RE components in relation to aspecific health complaints. Habitual RE of 444 hospital employees were measured (with optical correction if applicable) using an autorefractometer (Topcon, RM-8000B). Health complaints were assessed in a questionnaire (Dutch Questionnaire of Work and Health, VAG). The relation between various habitual RE components and health complaints was analysed by analysis of variance (ANOVA), for both eyes separately.
Habitual spherical RE of all employees revealed prevalences of 7% for myopia >0.50D and 19% for hyperopia >0.50D. Astigmatism > 0.50D was found in 65%; of these cases, 57% showed horizontal/vertical orientation and 43% oblique orientation. Between right and left eyes, and between employees with and without optical correction, no differences were found in the prevalence of the various habitual RE components. In employees normally wearing an optical correction (58% of all employees), no differences in health complaints were found for the various refractive components. However, in employees normally not wearing an optical correction, higher health complaints scores were found in those with spherical hyperopia and myopia. On a health-scale ranging from 0.00 to 1.00, emmetropes scored 0.18 whereas myopes and hyperopes scored 0.24 and 0.29 respectively (p=0.03). In relation to health complaints, other RE components investigated did not play a role. Spherical hyperopia and spherical myopia proved to be a risk factor for aspecific

health complaints in employees normally not wearing an optical correction. No relation was found between all other investigated optometric components of habitual RE and aspecific health complaints. Since spherical RE can be corrected relatively easy, attention for these errors is advisable.

In chapter 7 we investigated the relation between habitual RE, aspecific health complaints and sickness absence. Habitual RE of 423 hospital employees was measured using an autorefractometer (Topcon, RM-8000B) and related to aspecific health complaints and sickness absence. Health complaints were measured using a questionnaire. Sickness absence was assessed on the basis of organizational absence records. Analysis of variance (ANOVA) and multiple logistic regression analysis were used.
A direct relation between habitual RE and sickness absence was not found. On a scale ranging from 0.00 to 1.00, hyperopes (19% of all employees) reported more aspecific health complaints than emmetropes (0.23 versus 0.16; p=.01). Hyperopic men (0.19 versus 0.12; p=.05) and hyperopic employees aged 40 years or older (0.25 versus 0.15; p=.01) reported more aspecific health complaints, than their emmetropic counterparts.
Compared to employees with low health complaint scores, employees with high health complaint scores were absent one episode more per two years (p=.01); also their average sickness episode lasted 14 to 23 days longer (p=.02). In total this group showed a higher total sickness absence of 16 to 26 days per year (p<.01).
We did not find a direct association between refractive error and sickness absence. The prevalence of habitual RE in employees is relatively high. Spherical component of habitual RE is associated with health complaints. Accordingly, besides measuring visual acuity in screening programs, the measurement of habitual RE is worthwhile considering.

Now RE in the previous chapters has been indicated one of the possible risk factors for aspecific health complaints and functional problems, for health care workers in ambulatory settings a reliable and feasible method to detect RE is necessary. We investigated in chapter 8 the additional diagnostic value of using plus-lenses next to visual acuity (VA) measurement in order to detect RE in ambulatory settings
In a cross-sectional study REs of 520 children, aged 11-13 years, were measured using an autorefractometer (Topcon, RM-8000B). Autorefractive measurements were used to categorize ametropia. Using an ETDRS chart, VA was measured without and with spherical plus-lenses (S+0.50D and S+1.00D). Sensitivity and specificity for detecting RE by VA-measurements without and with use of the plus-lenses were used to plot ROC curves, using autorefractor measurements as the reference standard.
No differences were found in the prevalence of the various components of RE between right and left eyes. RE measurements revealed 74% emmetropia [+0.50D, -0.50D], 14% myopia <-0.50D, and 12% hyperopia >+0.50D. Astigmatism >0.50D was present in 33% of the children.
ROC curves for VA-measurements alone showed an Area Under the Curve (AUC) for myopia of 0.71 (Confidence Interval 0.66-0.77); for hyperopia 0.57 (0.49-0.64), and for astigmatism 0.63 (0.58-0.68).

VA-measurement with use of plus-lenses (0.50D) showed for myopia an AUC of 0.42 (0.37-0.48), for hyperopia 0.72 (0.65-0.78), and for astigmatism 0.55 (0.50-0.60). Both used plus-lenses showed equal results in this respect.
Based on ROC curves optimal sensitivity/specificity profiles were reached for myopia using VA-measurements only (63%/78%; odds ratio 6.0), for hyperopia using VA-measurements in combination with plus-lenses (67%/75%; odds ratio 6.1) and for astigmatism using VA-measurements only (58%/73%; odds ratio 3.0).
In ambulatory settings, simple VA-measurement (i.e. without plus-lenses) is a reasonably valid low-tech method to detect myopia, but not for hyperopia and astigmatism. The use of plus-lenses next to VA-measurement is of significant importance in detecting hyperopia.

The general conclusions of our study on the relation between REs, aspecific health complaints and functional problems reveal that small habitual REs are associated with aspecific health complaints and functional problems (chapter 9).
The question arises whether correction of these RE with glasses will diminish these complaints and problems. If further prospective research confirms our findings, and if correction of habitual RE will lead to diminished aspecific health complaints and/or functional problems, a screening-study for habitual RE is worthwhile